DOCUMENT RESUME

ED 263 194 TM 850 685

AUTHOR Elias, Barbara P.
TITLE Programming and Problem Solving.
PUB DATE 8 Feb 85
NOTE 8p.; Paper presented at the Annual Meeting of the Eastern Educational Research Association (8th, Virginia Beach, VA, February 7-9, 1985).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; *Cognitive Style; *Computer Assisted Instruction; Decision Making; Elementary Education; Grade 5; *Heuristics; Learning Processes; *Learning Strategies; *Problem Solving
IDENTIFIERS *Apple IIe; LOGO Programing Language

ABSTRACT

A study was conducted to examine computer programming as a problem solving activity. Thirteen fifth grade children were selected by their teacher from an above average class to use Apple IIe microcomputers. The investigator conducted sessions of 40-50 minutes with the children in groups of two or three. Four problems, incorporating the programming content from the Logo unit as well as an element of incompleteness, were typed on individual index cards and explained to the children. As the children solved the problems, they wrote down each command used. A tape-recorded interview with each child followed the problem session. Most strategies followed a trial and error pattern. All children solved the first two problems, ten solved three, and one solved all four. Results indicate that Logo learning, at the introductory level, has the potential for use in problem solving tasks. (Author/LMO)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED263194

PROGRAMMING AND PROBLEM SOLVING

A Paper Prepared for the

Eastern Educational Research Association

Virginia Beach, Virginia

February 8, 1985

by Barbara P. Elias

Virginia State University

Petersburg, Virginia

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

B.P. Elias

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

TM 850 685

PROGRAMMING AND PROBLEM SOLVING

Abstract

A pre-experimental study was conducted to examine computer programming as a problem solving activity. Thirteen 5th grade children were observed and interviewed during a 40-50 minute session with four Logo programming tasks presented as problems to be solved. Results indicate that Logo learning, at the introductory level, has the potential for use in problem solving tasks. Possible questions for experimental investigation are discussed.

Introduction

Problem solving skill deficiencies continue to be in evidence in our schools ("A Nation At Risk", 1983). One possible approach to finding solutions to this problem is to study the usefulness of computer programming using the computer language Logo. Logo is viewed as an appropriate medium for enhancing problem solving ability because of the kind of learning environment it provides (Bull, 1982; Papert, 1980) and because of the number of similarities which are thought to exist between programming and general problem solving. Both are thought to require the higher cognitive skills, utilize planning, problem decomposition, the testing of hypotheses and heuristics (Nickerson, 1982). Previous studies point to the potential of Logo for studying problem solving style (Watt, 1979) and certain types of problems (Statz, 1973). The direct teaching of problem solving skills with Logo (Pea, 1983) is an area that may require investigation.

The purpose of this study was to explore ways in which children who have had Logo instruction solve problems which involve Logo. Programming

tasks were presented as problems to be solved. An additional purpose was to seek answers to the following questions. What kinds of strategies do children employ in solving these problems? What kinds of errors are made? What problem solving styles are evident? Is planning involved? Are the selected problems routine or nonroutine for the children in this study? The results may be helpful in designing an experimental investigation of Logo and problem solving.

Subjects, Materials and Procedures

The subjects for this study were thirteen 5th grade boys and girls, 10 to 11 years old, from an elementary school in southside Virginia. They were members of a class of above average students. The school is predominately white with a large population of black children. The children come from a fairly diverse group of families, including farmers, laborers and professionals. Subjects were selected by their teacher to participate. Sessions were conducted in a multi-purpose room at the school. Apple IIe microcomputers, which were in use at the school, were used. Sessions of from 40-50 minutes were conducted with the children in groups of two or three. The investigator conducted each session.

Materials included a Logo Command Chart, transparency overlays for problems 1 and 2, individual sets of problems on large index cards, individual writing pads and pencils. Four problems were used in this study. They were developed to incorporate the programming content from the Logo unit studied by this class as well as an element of incompleteness. The problems were typed on individual index cards as follows:

1. Move the turtle, through the maze, to the house at the top of the maze. The turtle should not go through the wall. (Turtle located at the entrance to the maze at the lower part of the monitor.)

2. Move the turtle to the house at the top of the screen by using only two kinds of commands, FD and RT. You may use FD and RT as many times as needed. (Turtle located at the center of the monitor.)

3. Write a procedure which makes one of these designs. You may choose from the window, the house or the flag. Draw the design that you choose on your paper.

4. Write a procedure which makes this shape. (A circle)

Each session included introductions, an explanation of the purpose of the activity and a few minutes to get re-acquainted with Logo. Problems were explained, one at a time, and the children were asked to write down each command typed on the keyboard. After a problem was finished, an interview was conducted which was tape recorded. First, they were asked to explain how each problem was solved. Then, for Problem #1, they were also asked to give a reason for choosing the path through the maze. Two questions followed the initial response to Problem #2. (1) If you had to do this problem again, could you do it using fewer commands?, and (2) What is the smallest number of commands you would need? For problem #3, each child was also asked to give a reason for choosing the design selected as a problem to be solved. Those who were not able to complete Problem #4, were asked to explain what else needed to be done.

Results and Discussion

All children were able to solve the first two problems. Ten children solved the first three problems. Only five children attempted Problem #4 because of the lack of time. One child was able to solve this problem. Problems #1 and #2 were scored as solved if the specified tasks were accomplished. Problems #3 and #4 were considered solved if the design made by the student had the same general characteristics of the target design. Size of the design was not a factor in the scoring. Table 1 summarizes the results of the study.

Table 1

Problem	1	2	3	4
Solved (Correctly)	13	13	7	5
Solved (Incor.)	0	0	3	4
Avg. Commands	22	15	25	15

In general, children spent time studying each problem before beginning. Most strategies incorporated trial and error. Note the average number of commands for each problem. The smallest number of separate commands for Problem #1 and #2 are 6 and 2 respectively. No written plans or drawings were used by the children. A record of errors was not possible. The problems were rated as "easy", "hard", and "in between". Problems #1 and #3 were most often rated as "easy" and Problems #2 and #4 were most often rated as "hard". All were able to clearly express themselves during the interview.

Problem #1 results indicate that interior paths, chosen by four children, and peripheral paths, chosen by nine children, were selected primarily because the children thought they would be easy to do. Two children who chose interior paths felt that they would be more challenging. Problem #2 results produced patterns ranging from a straight line to a "square spiral". All children felt that a second try at this problem would produce a procedure with fewer steps. Seven children chose the window design and four children chose the flag design for writing procedures for Problem #3. Only two students, however, showed evidence of modularity in their solutions. Only one child wrote a procedure which made a circle. Two procedures produced a hexagon and an octagon.

The potential for teaching problem solving with Logo should be investigated further. One possible approach may be the study of multiple solution Logo tasks in teaching problem solving through problem analysis. Of what

value is the element of challenge in Logo problem solving tasks? Should Logo experiences emphasize problem solving?

REFERENCES

A nation at risk. (1983, May 4), Chronical of Higher Education. pp. 11-16.

Bull, G. (1982). Microworlds. The Computing Teacher. 9. 62-23.

Nickerson, R.S. (1982). Computer programming as a vehicle for teaching thinking skills. Thinking: The Journal of Philosophy for Children. 4. 42-48.

Papert, S. (1980). Mindstorms: Children, computers and powerful ideas. New York: Basic Books.

Pea, R.D. (1983). Logo programming and problem solving. (Technical Report No. 12). New York: Center for Children and Technology, Bank Street College of Education.

Statz, J.A. (1973). Development of computer programming concepts and problem solving abilities among ten-year-olds learning logo. Unpublished doctoral dissertation, Syracuse University.

Watt, D. (1979, December). A comparison of the problem solving styles of two students learning logo: A computer language for children. Creative Computing, 5. 86-90.